Evaluation of surface quality after profiled milling of alder and birch wood

EA SALCA, A Fotin, I Cismaru - EVALUATION, 2008 - proligno.ro

Abstract: The present paper presents a comparative study upon the quality evaluation of profiled surfaces obtained by milling, for alder and birch wood, as well as the influence of the processing regime upon the surface roughness. The samples were profiled milled on the ...

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A Outahyon - 2008 - pastel.archives-ouvertes.fr

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A FOTIN, I CISMARU, M CISMARU, E SALCĂ - Pro Ligno, 2010 - proligno.ro

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A FOTIN, I CISMARU, EA SALCA, M CISMARU - proligno.ro

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TOTAL ROUGHNESS OF PROFILED SURFACES MADE OF BLACK ALDER WOOD

S Emilia-Adela - researchgate.net

Abstract: The paper is focused on the roughness evaluation of profiled samples made of black alder (Alnus glutinosa) as well as the influence of the processing schedule upon it. The samples were processed with the help of a profiled milling cutter on the vertical ...

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B Thibaut, L Denaud, R Collet, R Marchal… - Annals of Forest …, 2015 - Springer

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Citaţi Salvaţi

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Lucrarea prezinta un studiu comparativ asupra evaluarii calitatii suprafetelor profilate obtinute prin frezare, in cazul lemnului de arin si mesteacan, precum si influenta regimului de prelucrare asupra rugozitatii suprafetei. Epruvetele au fost prelucrate prin frezare cu **...**
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OPTIMIZATION OF WOOD MILLING SCHEDULE – A CASE STUDY

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OPTIMIZATION OF WOOD MILLING SCHEDULE – A CASE STUDY

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Abstract

The paper presents the results of a case study applied to the milling process of solid wood specimens made of black alder wood (Alnus glutinosa L. Gaertn.) with a view to find the optimal cutting schedule when two main criteria, such as the minimum power consumption and the best surface quality are fulfilled.The experimental work was performed with black alder wood originating from mature trees from the Buzau Valley region in Romania. All samples were processed on their longitudinal edges by straight milling with a milling cutter having glued straight plates on the vertical milling machine under different cutting schedules. An electronic device connected to the machine engine and an acquisition board were used to record and compute the power consumption during milling. Roughness measurements of the samples were performed by employing an optical profilometer. All data were processed using the regression method and variance analysis. The study revealed that best results are to be obtained in terms of cutting power and surface quality when processing with low feed speeds and light cutting depths.

Key words: *black alder; milling; optimization; cutting schedule; roughness.*

INTRODUCTION

Simple, plane and also complex shape surfaces are obtained when wood suface is processed by milling. The rational and economic correlation of the optimal cutting schedule parameters depends on certain criteria, such as: surface quality (Aguilera and Martin 2001; Malkocoglu 2007), cutting dynamics (Vega and Aguilera 2005), acoustic pressure (Cyra and Tanaka 2000; Vega and Aguilera 2005) and cost (Taran 1973). Wood species (Burdurlu et al. 2005; Malkocoglu and Ozdemir 2006), cutting speed (Rousek and Kolarik 2004; Rousek and Kopecky 2005), feed speed (Costes and Laricq 2002; Huang et al. 2003), cutting depth and processing direction to the grain orientation and annual rings (Ohta and Kawasaki 1995; Wong 2002; Salca 2008) are essential elements for an optimal cutting process selected under scientific bases.

Therefore surface quality and power consumption are to be considered essential criteria based on which an optimum for the cutting process may be achieved.

The workability properties of black alder wood are less known and studied. The absence of data has represented a serious obstacle for its use in wood industry and furniture manufacturing in Romania. Some research works were carried out on the rip sawing and planning processes, especially (Malkocoglu and Ozdemir 2006) and a special attention was granted to drying because most of the problems appear during this process (Kivisto and Marketta 1999).

The present work is part of a research project focused on black alder wood native in Romania which tried to capitalize this wood species to be further used in furniture manufacturing.

OBJECTIVE

The main objective of the present research was to evaluate the cutting process by longitudinal milling applied to solid wood specimens made of black alder, in order to find an optimal schedule with respect to a minimum cutting power and the best surface quality.

MATERIAL, METHOD

Samples made of black alder (*Alnus glutinosa L. Gaertn*.) wood provided by Robur Company in Nehoiu, Buzau were processed on their longitudinal edges (1000mm length at 8% MC) by straight milling with a milling cutter (100mm diameter) having glued straight plates made of CMS (sintered carbide) on the vertical milling machine of MNF10 type. The machine technical characteristics are presented in Table 1. Based on the factorial experiment with three variables (feed speed, cutting depth, cutting width), 20 specimens per each milling process and rotation speed were used. The experimental schedule is presented in Table 2.

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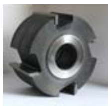
Table 1

Technical characteristics of MNF10

Characteristic	SI	Value
Dimensions of main table	mm	1100 x 960
Table displacement perpendicularly to the feed direction	mm	160
Dimensions of mobile table	mm	1100 x 350
Maximum displacement of mobile table	mm	900
Vertical displacement of working shaft	mm	160
Inclination angle of working shaft	degree	0...45
Rotation speed of working shaft	rot/min	3000/4500/6000/9000
Rotation speed of electric motor	rot/min	1500/3000
Power of electric motor	kW	2,2/2,8
Overall dimensions	mm	1530 x 2125 x 1340
Weight	kg	1300

Table 2

Experimental schedule

Milling cutter, 100 mm	Processing direction	Rotation speed, rot/min	Cutting width, mm	Feed speed, m/min	Cutting depth, mm
	longitudinal	6620 9732	20 25 30 35 40	4.5 9 13.5 18 22.5	1 2 3 4 5

Power measurement

An electronic device connected to the machine engine and an acquision board of ADC11 type were used to record and compute all data (Fig. 1 and Fig. 2).

The power during milling was recorded at milisecond (Fig. 3). Data were processed by using Datafit and Delphi as software. A non-linear regression method was then applied by respecting an equation of 2nd degree type with three variables (eq. 1) followed by an SPSS variance analysis. The efective cutting power was computed as difference between the recorded power and the idle power for each one of the specimens.

$$Y = a + bx_1 + cx_2 + dx_3 + ex_1x_2 + fx_1x_3 + gx_2x_3 + hx_1^2 + ix_2^2 + jx_3^2 \qquad (1)$$

where: the three variables (x_1, x_2, x_3) are as follows: feed speed (u), cutting depth (h) and cutting width (b), respectively.

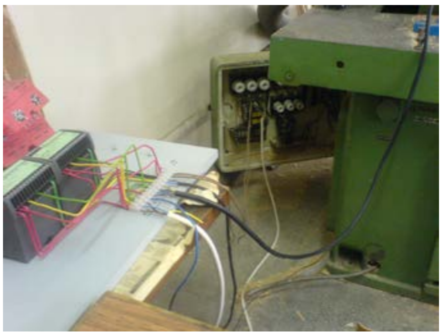


Fig. 1.
Electronic device and MNF10

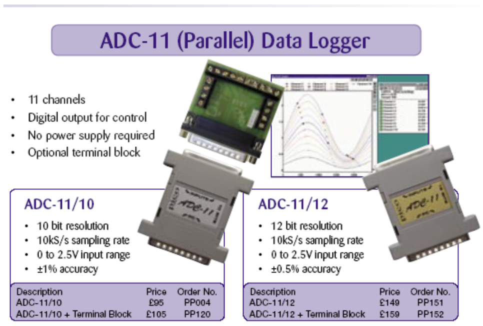


Fig. 2.
Acquisition board of ADC11 type

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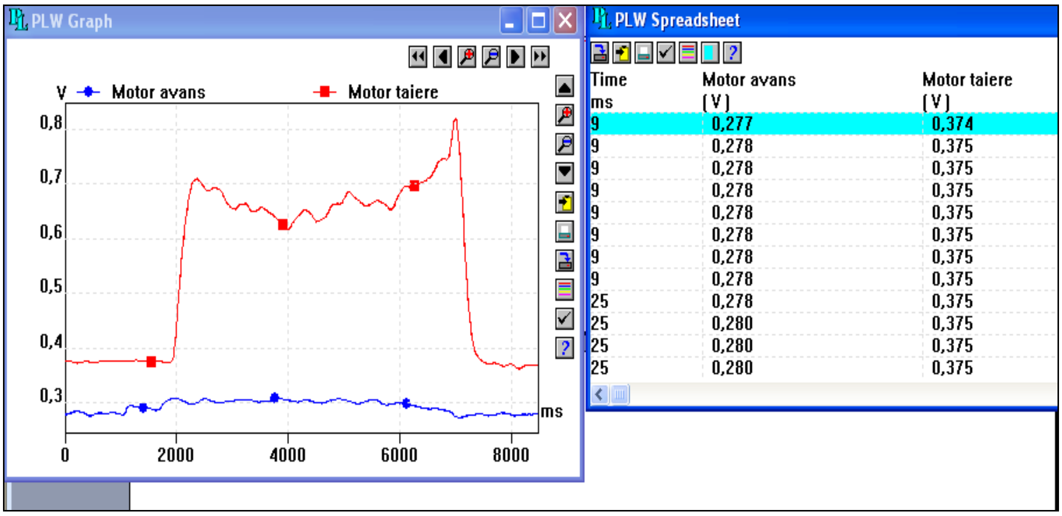

Fig. 3.
Data display for cutting power (red line-cutting; blue line- feed)

Roughness measurements of the samples

An optical profilometer of MicroProf FRT type with white light was used for roughness measurements (Fig. 4). The scanning parameters were selected according to the reccommendations for wood surfaces: 2D scanning mode, 750µm/s scanning speed, 10000points per line, 50mm evaluation length, 2.5mm sampling length, 5µm resolution (Gurau 2007).

All samples were measured along the processing direction. According to ISO 13565-2:1996 standard, Rk (the roughness core depth) was evaluated as being the most representative processing roughness indicator (Sandak and Martino 2005; Gurau 2007). The roughness profile was achieved after a pre-filtering of data by using a Gaussian filter, implicitly applied.

All data were processed by using the same regression method (eq.1) and variance analysis. Specific segments of modelling in correlation with those established under industrial conditions and according to the speciality literature were analysed.

Some extreme values were removed and just three feed speeds (9, 13.5 and 18m/min) and three representative cutting depths (1, 2, 3mm) for a cutting width of 30mm were selected.

The cutting width does not influence the surface quality but it has an important impact upon the dynamic elements of the milling process, having an indirect influence upon surface.

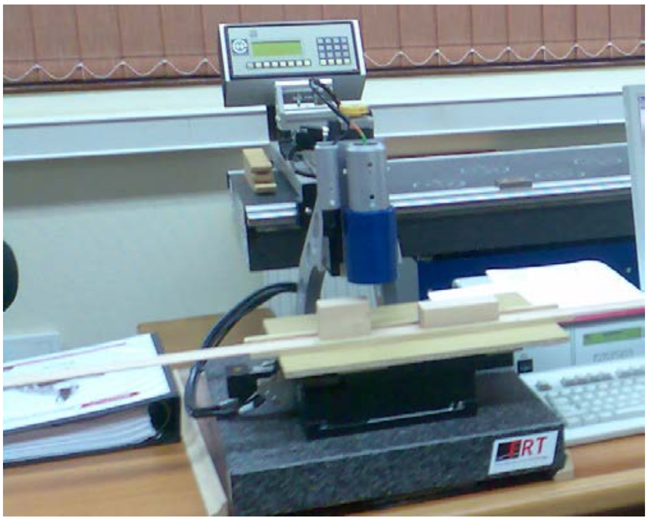

Fig. 4.
MicroProf FRT roughness device

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RESULTS AND DISCUSSION

3D response surfaces showing the variation of power consumption and Rk roughness parameter for straight milled longitudinal surfaces of black alder wood were achieved.

Two 3D spectacular surfaces are offered as examples in Fig. 5 and Fig. 6. They present the variation of power consumption and processing roughness as function of feed speed (u), cutting depth (h) and cutting width (b) during longitudinal milling at two rotation speeds, namely 6620rot/min and 9732 rot/min. Each surface corresponds to a certain cutting width.

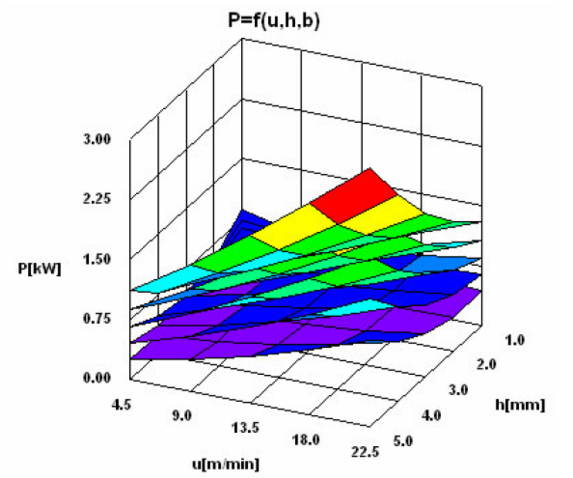

Fig. 5.
Variation of power consumption as function of cutting schedule during longitudinal milling at 6620rot/min

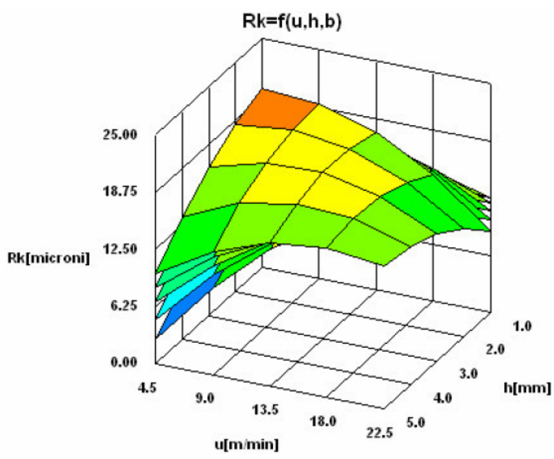

Fig. 6.
Variation of roughness parameter, Rk as function of cutting schedule during longitudinal milling at 9732rot/min

The variation of power consumption during the longitudinal milling of wood samples when using both rotation speeds and same cutting schedule for a cutting width of 20mm is presented in Fig.7. The cutting power decreased with the increase of cutting depth up to 3 or 4mm for low feed speeds and up to 1 or 2mm for higher feed speeds when the cutting process was performed at 6620 rot/min for a cutting width ranging from 20 to 35mm. A parabolic increase of the cutting power occurred after that. When processing samples with low cutting width at a rotation speed of about 9732 rot/min, the decrease of cutting power appeared very soon for 1 and 2mm as cutting depth, as shown in Fig. 7. In this case a minimum value of about 0,7kW was set at 4,5m/min as feed speed and 2mm as cutting depth. For cutting widths higher than 30mm, the cutting power increased for any feed speed. The cutting width and rotation speed presented significant effects on the cutting power and a significant cumulative effect of feed speed and cutting depth was also noticed (Sig<0.05 and η^2>0.5).

Fig. 8. presents the variation of processing roughness, Rk as function of feed speed (u), cutting depth (h) during longitudinal milling at two rotation speeds of 6620rot/min and 9732rot/min for a cutting width of 30mm. The processing roughness expressed by Rk parameter respected and increased trend once the feed speed and cutting depth increased when processing at a rotation speed of 6620rot/min, while just a light increase was noticed when processing at 9732rot/min. The best surface quality expressed by Rk minimum value of about 12.4µm was achieved when milling at 6620rot/min with a feed speed of about 9m/min for 1mm as cutting depth. A significant cumulative effect of rotation speed and feed speed on roughness parameter was established (Sig<0.05). The relation intensity was pointed out by η^2>0.5, which indicated their important interaction upon the processing roughness parameter.

CONCLUSIONS

The study revealed that an optimal cutting schedule can be obtained when using and combining two main criteria for processing optimization, such as the minimum power consumption and the best surface quality. The cutting power is mainly influenced by the cutting width apart of other cutting variables when compared to surface roughness. It appeared that best results are to be obtained in terms of cutting power and surface quality when processing with low feed speeds and light cutting depths. Data obtained in this study may be successfully used in wood industry.

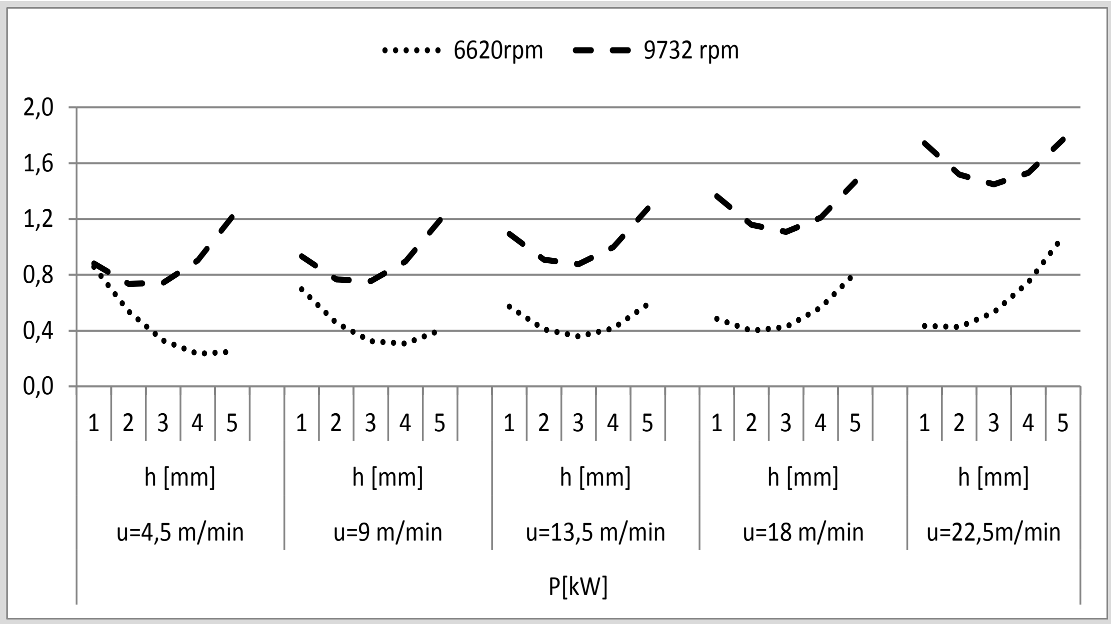

Fig. 7.
Variation of power consumption as function of feed speed (u), cutting depth (h) for 20mm as cutting width (b) during longitudinal milling at 6620 and 9732rot/min

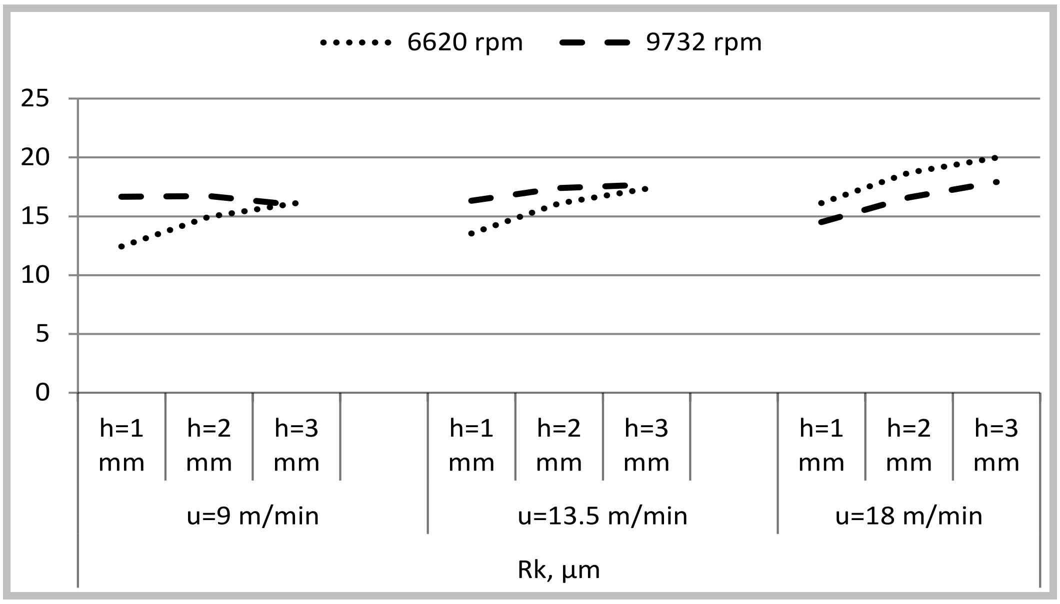

Fig. 8.
Variation of roughness parameter, Rk as function of feed speed (u) and cutting depth (h) for 30mm as cutting width (b) during longitudinal milling at 6620 and 9732rot/min

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Forestry and Wood Technology № 95, 2016: 148-153
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Influence of milling and sanding on beech wood surface properties. Part I. Surface morphology

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Abstract: *This work investigates the influence of beech wood mechanical treatment on specific surface properties of this wood. The aim of this part has been to recognise milling and sanding-induced physical modifications of beech wood surface morphology assessed through roughness and waviness parameters.*
The experimental results show different impacts of different mechanical treatments of beech wood surface on the surface morphology assessed through roughness and waviness parameters. Smoother surfaces were obtained by milling, however without significant influence of the milling parameters (rotation rate and shifting speed). In all cases, the sanded surfaces displayed significantly more roughness than the milled ones. The key factor influencing the roughness parameters was the grain size. In all cases, roughness was greater in the direction perpendicular to grain.

Keywords: beech wood, sanding, milling, surface morphology, roughness, waviness

INTRODUCTION

Wood surface morphology depends on multiple variables (wood species, heterogeneity, mechanical treatment of wood surface, goal-directed surface pre-treatment, moisture content, ageing, and similar). For wood gluing and/or surface treatment, modifications to wood surface morphology induced by particular pre-treatment are necessary to identify and quantify, since wood surface morphology significantly affects wood wetting with film-forming materials as well adhesion of these materials to wood. This explains why this aspect of the problem is very much concerned today (AYRILMIS 2010, VÁZGUEZ *et al.* 2011, SANTONI and PIZZO 2011, HUANG *et al.* 2012, QIN *et al.* 2014, HUBBE and GARDNER 2015, BEKHTA and KRYSTOFIAK 2016, and others.).

Wood surface morphology needs to assess both anatomically and physically. The physical approach means quantifying roughness and waviness parameters (GURAU 2007, 2013, CZANADY and MAGOSS 2011). Waviness, also referred to as secondary surface texture, generated by mechanical treatment in interaction between the cutting tool and wood, represents unevenness patterns repeated regularly, while the wavelength of these patterns is bigger than the sampling length of the measured segment investigated in roughness. This is especially typical for milled surfaces. In this case, the waviness depends on the cutting tool parameters, its rotation rate and shifting speed as well as on the treated wood quality, heterogeneity, anisotropy and similar (AICHOUH 2003).

Roughness, also referred to as primary texture, apparently depends on the internal wood anatomy and wood surface treatment. Consequently, for a real wood surface, the technical parameters of the cutting tool and machining method always need to be considered (GURAU 2013, CZANADY and MAGOSS 2011, FOTIN *et al.* 2013 and others). Various types of mechanical surface treatment do not only influence the surface alone but also wood chemical structure and consequently wood wetting and its thermodynamic characteristics (GARDNER *et al.* 1991, LIPTÁKOVÁ *et al.* 1995, KÚDELA and LIPTÁKOVÁ 2005, SANTONI and PIZZO 2011).

The objective of this part of the work was to assess surface geometry in milled and sanded beech wood through its roughness and waviness parameters.

MATERIAL AND METHODS

The experimental measurements were carried out on specimens prepared from radial and tangential beech timber wood. The impact of up cutting, parallel to grain, was studied on test specimens sized 200 × 100 × 35 mm. The surface morphology was evaluated on lateral tangential and radial specimen faces.

The impact of sanding was studied on specimens 40 × 40 × 40 mm in size. This size was in compliance with dimensions and design of the equipment for surface sanding.

The test specimens were conditioned at a relative air humidity of 65 % and a temperature of 20° C to an equilibrium moisture content of 12 %.

The milling of specimens' surface was performed with the aid of a milling cutter ELU MOF 177E with a power of 1800W/1100W. There were used three rotation speeds of the cutting: 14 130 rpm; 17 500 rpm; 20 400 rpm and two specimen feed speeds – 315 and 630 mm/min. The depth of cut was 2 mm and was constant for full experiment.

The surface sanding was performed with a grinding machine SKIL Baseline – type 1100, with a power of 560 W. The abrasion belt dimensions were 76 mm × 457 mm, the grain sizes were three: P80, P120 and P150. The cutting speed was 200 m/min, the adherence pressure was 41 N.

The roughness and waviness were assessed on radial and tangential faces, parallel and perpendicular to the grain, through the following roughness parameters of the profile: Ra – arithmetic mean deviation, Rq – root-mean-square deviation, Rz – maximum height of the assessed profile within a sampling length, R_{Sm} – mean distance between the valleys, Rt – maximum height of the assessed profile within the total length. The waviness was evaluated through the Wa parameter. The sampling length was 2.5 mm, the total measured length was 30 mm. The roughness and waviness parameters were measured with a profilometer Surfcom 130A.

RESULTS AND DISCUSSION

The data characterising the milled and ground surface roughness and waviness are presented in Tables 1 and 2. The investigated factors' (machining way, anatomical direction, radial and tangential face) impacts were evaluated with the aid of multi-way variance analysis. The milled surfaces were also analysed for the influence of milling parameters, especially rotation rate and shifting speed. In the sanded surfaces, the effect of the grain size was assessed.

The multi-way variance analysis resulted in confirming significant influence of beech surface machining way and also of other factors studied here on the roughness and waviness parameters of this wood surface. In most cases, there was also found significant influence of factors acting in interactions.

All the milled surfaces demonstrated less roughness than the sanded ones. The results demonstrate their relatively high variability. The milling parameters (rotation rate, shifting speed) were confirmed as a significant factor, they were not, however, found influencing the roughness R and waviness W parameters. The variability in these parameters seemed more random, associated with the material variability.

The waviness parameters Ra, Rz, Rq and Rt perpendicular to the grain were significantly higher than parallel to grain. Higher roughness values were observed on radial surfaces than on tangential ones. This can be explained by alternating spring and late wood bands. On the other hand, there were no differences in roughness between radial and tangential surfaces. There were no significant differences in Wa parameter between radial and tangential surfaces in the longitudinal direction. This parameter values depended on the cutting tool alone.

Comparison between milled and microtomed beech wood surfaces resulted in finding that plane-milling induced cell walls distortion and, as a consequence, their imperfect cutting (Fig. 1a, b), which is in accord with LIPTÁKOVÁ and KÚDELA (2005) who report that the plane milling can cause, under common performance conditions, considerable distortion of cell walls, their compression and imperfect cutting, followed by wood fibre tearing off. In our laboratory conditions, these phenomena were not as evident as those reported by the cited authors. They may act stronger in practice, due to cutting edge blunting in common steel tools.

Table. 1 Basic statistical characteristics describing beech wood roughness *R* and waviness *Wa;* milled surfaces. (n = 30)

Basic statistical characteristics	Roughness and waviness parameters											
	Ra	Rq	Rz	Rsm	Rt	Wa	Ra	Rq	Rz	Rsm	Rt	Wa
	(μm)						(μm)					
	Perpendicular to grain						Parallel to grain					
	Tangential surface											
	14 130/315											
x (μm)	3.67	5.36	38.33	329.53	92.39	3.36	2.70	3.59	19.92	682.77	44.45	3.84
s (μm)	0.29	0.34	2.55	41.91	22.46	0.30	0.26	0.46	2.80	105.61	17.56	0.73
	14 130/630											
x (μm)	4.52	6.80	46.96	402.92	94.38	2.52	3.16	4.30	26.07	643.64	71.79	4.18
s (μm)	0.60	1.24	8.07	143.88	26.30	0.04	0.72	1.08	9.00	52.90	21.16	0.96
	17 500/315											
x (μm)	3.77	5.07	32.65	339.82	66.05	3.64	2.43	3.12	16.16	644.76	27.79	3.05
s (μm)	0.22	0.39	2.48	26.40	20.05	0.75	0.60	0.78	4.05	61.77	8.47	0.49
	17 500/630											
x (μm)	3.48	4.93	36.03	330.84	64.61	2.59	2.43	3.16	17.56	716.19	31.66	3.52
s (μm)	0.34	0.42	3.84	38.75	13.94	0.34	0.27	0.32	1.14	179.7	6.74	0,71
	20 400/315											
x (μm)	3.84	4.99	31.55	340.44	59.23	3.97	2.39	3.07	15.45	782.28	28.71	3.23
s (μm)	0.30	0.34	1.94	34.22	12.67	0.45	0.52	0.76	3.80	83.95	6.83	0.43
	20 400/630											
x (μm)	3.89	5.61	38.32	394.75	97.88	3.56	2.82	3.75	18.99	622.33	41.23	3.41
s (μm)	0.29	0.57	2.89	92.54	26.43	0.38	0.70	0.90	3.58	86.99	5.06	0.40
	Radial surface											
	14 130315											
x (μm)	5.94	7.65	42.78	464.31	93.87	11.01	2.70	3.67	22.22	728.82	42.87	4.13
s (μm)	0.51	0.63	3.33	40.05	23.18	0.82	0.15	0.26	1.92	117.15	7.33	0.44
	14 130/630											
x (μm)	5.03	6.69	40.18	467.40	73.14	10.92	3.04	3.90	20.56	775.91	38.91	4.30
s (μm)	0.20	0.47	4.22	97.50	3.95	0.81	0.49	0.60	2.15	126.20	6.09	0.38
	17 500/315											
x (μm)	5.19	6.66	38.17	494.62	71.37	6.30	2.93	3.80	19.69	725.57	38.40	5.14
s (μm)	0.17	0.20	0.97	42.59	16.82	0.29	0.24	0.34	1.64	187.37	7.45	0.27
	17 500/630											
x (μm)	4.59	6.18	38.66	392.47	59.77	3.44	2.85	3.67	19.31	697.06	40.10	4.10
s (μm)	0.16	0.25	1.80	26.24	5.31	0.07	0.32	0.45	3.82	175.09	8.94	0.55
	20 400/315											
x (μm)	5.17	6.96	41.53	437.80	98.49	4.22	3.14	4.09	21.17	767.17	38.13	5.64
s (μm)	0.61	1.25	6.67	56.47	21.41	0.12	0.28	0.41	1.91	217.67	6.36	1.42
	20 400/630											
x (μm)	4.70	6.16	36.81	419.28	86.77	4.16	2.62	3.46	19.50	763.38	39.52	4.42
s (μm)	0.16	0.13	0.56	122.03	15.82	0.57	0.17	0.21	1.15	168.74	1.17	0.38

In the sanded surfaces, there were evaluated their roughness and waviness parameters influenced by the same factors as in the case of the milled surfaces. At the same time, there was assess the impact of the sanding grain size on the roughness parameters concerned (Table 2). Unlike in the milled surfaces, in most of the sanded ones, the roughness parameters were not found significant influenced by factors acting in interactions.

The major impact on the roughness parameters was found for the sandpaper grit number. The highest roughness parameters were obtained after sanding with a paper with P80, than the roughness decreased with rising grain size. Our results well correspond to VITOSYTE *et al* (2012).

The differences in roughness between the anatomical directions were the consequence of the cell elements orientation as well as of the sanding direction following the grain orientation. The anatomical plane was confirmed as an important factor, there was, however, found no correlation.

Table 2 Basic statistical characteristics describing beech wood roughness *R* and waviness *Wa;* sanded surfaces. (n = 40)

Basic statistical characteristics	**Roughness and waviness parameters**											
	Ra	**Rq**	**Rz**	**Rsm**	**Rt**	**Wa**	**Ra**	**Rq**	**Rz**	**Rsm**	**Rt**	**Wa**
	(µm)						**(µm)**					
	Perpendicular to grain						**Parallel to grain**					
	Tangential surface											
	P80											
***x* (µm)**	8.38	10.63	60.40	294.60	91.12	10.45	3.26	4.26	25.02	490.93	48.56	15.44
***s* (µm)**	0.93	1.13	6.03	35.99	17.89	3.13	0.69	0.90	4.96	93.96	15.18	3.86
	P120											
***x* (µm)**	5.83	7.49	46.04	227.89	74.38	11.24	2.88	3.74	21.61	438.03	39.98	15.87
***s* (µm)**	0.44	0.61	4.07	20.26	16.05	3.60	0.71	0.90	4.59	100.13	10.88	3.75
	P150											
***x* (µm)**	4.88	5.86	40.31	212.48	66.41	12.32	2.46	3.21	20.13	406.87	36.57	16.53
***s* (µm)**	0.48	0.41	4.09	25.48	15.15	3.53	0.67	0.52	5.33	88.13	8.94	3.09
	Radial surface											
	P80											
***x* (µm)**	8.86	11,28	63.73	304.56	97.15	8.97	3.95	5.23	30.63	541.62	60.85	14.89
***s* (µm)**	0.95	1.33	8.16	34.85	23.45	2.32	1.11	1.56	10.08	147.01	15.88	3.59
	P120											
***x* (µm)**	6.09	7.88	48.29	251.08	78.15	10.17	3.16	4.20	25.47	487.62	48.05	15.49
***s* (µm)**	0.65	0.87	5.59	22.20	18.48	2.87	0.78	1.04	6.53	116.91	15.57	3.76
	P150											
***x* (µm)**	5.14	6.04	42.54	235.19	69.65	11.84	2.75	3.62	22.38	425.86	43.80	15.84
***s* (µm)**	0.63	0.58	5.56	223.00	14.95	3.07	0.69	0.94	5.57	97.31	13.87	2.68

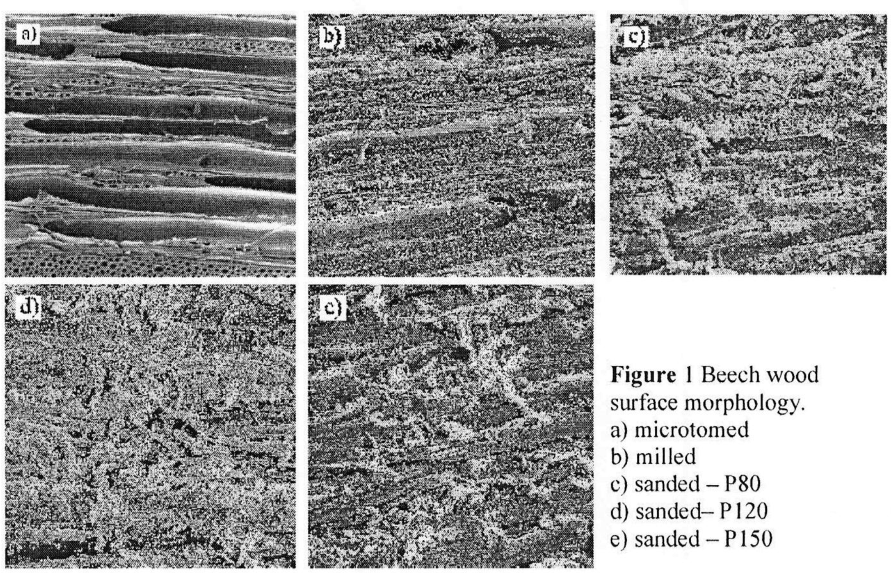

Figure 1 Beech wood surface morphology.
a) microtomed
b) milled
c) sanded – P80
d) sanded– P120
e) sanded – P150

The results imply that the beech wood sanding induced wood surface modification different from milling. The sanded wood surface morphology considerably depended on the sanding grain size (Fig. 1c, d, e).

The sanding caused wood fibres and other cell elements tearing off, distorting and even crushing. The wood dust generated was pressed into the pores, which resulted in somewhat smoothening the roughness. Important parameters were the grain size, sanding method (manual, machine) and sanding direction. On the other hand, the released wood fibre may swell and enhance the surface roughness, therefore, a new sanding of reinforced fibres is necessary.

Unlike roughness parameters, the waviness parameters *Wa*, manifested significantly lower values perpendicular to grain than parallel to grain.

These facts were also significantly reflected on more surface properties. These will be treated in the second part of this work.

CONCLUSION

The experimental results demonstrate that different machining ways had different impacts on the surface morphology evaluated through roughness and waviness parameters.

Less roughness was observed for plane milling, the milling parameters (rotation rate and shifting speed), however, did not significantly influence the roughness. The roughness of sanded surfaces was significantly higher. In the sanded surfaces, their roughness parameters were chiefly influenced by the sanding grain size.

In all cases, the wood surface roughness was higher perpendicular to grain than parallel to grain. This is in some contradiction to the fact that the machining considerably eliminated the roughness differences between these two directions. This phenomenon was manifested most evident in case of the sanded surfaces.

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Streszczenie: *Wpływ strugania i szlifowania na własności powierzchni drewna buka. Część 1. Morfologia powierzchni.* Praca dotyczy wpływu obróbki mechanicznej na wybrane parametry powierachni drewna buka. Celem tej części było opisanie wpływu strugania i szlifowania na morfologię powierachni ocenianą parametrami falistości i chropowatości.

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